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DATE: **November 22, 2002**

TO: **Coastal Commissioners and Interested Parties**

FROM: **Peter M. Douglas, Executive Director**
Elizabeth A. Fuchs, Manager, Statewide Planning and Federal Consistency Division
Mark Delaplaine, Federal Consistency Supervisor

RE: **Background Discussion for Commission Briefing by Dr. Peter Tyack High-frequency sonar tests to detect gray whales offshore of the San Luis Obispo County coast**

Under the Marine Mammal Protection Act, in August 2000 the National Marine Fisheries Service (NMFS) granted a scientific research permit (No. 981-1578) to Dr. Peter Tyack, a researcher with the Woods Hole Oceanographic Institution, to conduct a number of studies of the impact of noise on cetaceans in various oceans of the world. NMFS recently granted an amendment to this permit (No. 981-1578-03) authorizing an additional study within the California coastal zone, off the San Luis Obispo County coast near the Diablo Canyon Nuclear Power Plant. This particular study would involve using two types of high-frequency whale testing sonars, operating in the range of 20 to 40 kilohertz (kHz), to test the sonars' ability to detect gray whales migrating past the central California coast.

This area of the coast between Point Buchon and the Diablo Canyon Nuclear Power Plant provides a number of characteristics making it ideal for such types of research efforts, which is why it previously been used for several historic research efforts (Malme et al. 1983, 1984[1]; Tyack and Clark 1998), the latter of which the Commission reviewed and which consisted of a Navy-funded January 1998 research of the effects of low frequency sonar (100-500 Hertz (Hz))[2].

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[1] Malme CI, PR Miles, CW Clark, P Tyack and JE Bird (1984), Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Phase II: January 1984 migration; and Malme CI, PR Miles, CW Clark, P Tyack and JE Bird (1983), Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Bolt Beranek and Newman Report No. 5586 and 5366, respectively, submitted to Minerals Management Service, U. S. Dept. of the Interior.

[2] CD-153-97 (Navy, LFA, Phase II, off Big Sur) - Tyack, P.L. and C.W. Clark. 1998. Quick look -- Playback of low frequency sound to gray whales migrating past the central California coast - January, 1998.

Dr. Tyack's criteria for an ideal site include:

> · *Initial tests of large baleen whale should not involve endangered species until detection probability is determined and potential for behavioral disruption is checked*
>
> · *Should involve simple and reliable ability to track whales independent of the sonar*
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> · *Should occur in a difficult sonar environment for a challenging test*
>
> · *Should involve a large sample size where hundreds of whales can be tested in a few weeks*
>
> · *Ideally will enable testing of Target Strength of Whale as a function of aspect*

Dr. Tyack explains why this area meets these criteria as follows:

> *The proposed research is designed to address all three goals in a setting where hundreds of whales can be tested in a few weeks. This proposal suggests a test with gray whales migrating past the central California coast. The gray whale population has rebounded so well that it has been delisted, and in fact there are signs it is at or above carrying capacity. During 1999 and 2000 many emaciated whales were sighted and there was an elevated stranding rate, thought to result from inadequate feeding. During the past two years, 2001 and 2002, this problem has resolved and there is little reason to expect it to cause any changes to the study compared to earlier work. This is a setting where land stations can track with great reliability whales migrating a few kilometers offshore. The shallow waters provide a very challenging sonar environment, as there is a great deal of reverberation from the bottom. Several hundred whales pass by this coast each day. They are so well oriented on the migration, that it is easy to infer the aspect of the whale as it passes the sonar. The proposed study setting meets the criteria for a sonar validation test very well.*

Dr. Tyack intends to test two high-frequency (20 – 40 kilohertz (kHz)) active sonar systems designed to detect marine mammals within a mitigation zone: (1) a mechanically steered system; and (2) a more expensive phased array system (know as the "IMAPS" or "Integrated Marine Mammal Monitoring and Protection System"). These systems are described further in the attached study proposal (see Exhibit 1). NMFS' permit conditions (issued on October 1, 2002) for the amended permit (which includes the other activities being conducted in the North Atlantic Ocean, the Mediterranean/Ligurean Seas, and the Pacific Ocean near Hawaii) are also attached (see Exhibits 2 & 3). Research efforts *outside* California include cetacean tagging, following and sound playbacks in the Mediterranean and Ligurean Seas, the Bahamas, Gulf of Mexico and off the coasts of the Azores in the Atlantic Ocean, and the Hawaiian Islands in the North Pacific, in an effort to record acoustic stimuli cetaceans hear, and to measure vocal, behavioral, and physiological responses to sound over a five year period. The California research, however, would be limited to a three-week effort.

Dr. Tyack's application describes the purpose, methods, marine mammal monitoring measures and other provision for the California coast portion of the research effort. The following abstract summarizes the research; a complete description of the proposal is attached in full (Attachment 1):

> *The proposed research will track gray whales migrating past the central California coast, in collaboration with a group operating an innovative whale-finding sonar from a ship moored in the migration corridor. The tracking effort is designed to meet three objectives: validating the performance of the whale-finding sonar, measurement of whale return echo strength and characteristics, and measuring avoidance responses to the sonar of migrating whales. Whales will be tracked using surveyor's theodolites at two shore stations to pinpoint the location of about 1400 gray whale groups as they migrate past the study site in January 2003 on their southward migration from the Bering Sea to Mexico. By interpolating the expected position of the whales between surfacings, each sonar detection can be related to the whale tracks, and the range of detection and the probability of detection can be estimated as a function of range. Migrating whales are so oriented that it may also be possible to study the Target Strength of whales as a function of their aspect with respect to the sonar. Whales hearing a low frequency source in the migration corridor show an avoidance reaction, with about 50% avoiding exposure to received levels of about 140 dB re 1 µPa. The whale-finding sonar for the proposed research is normally operated at a source level after ramp-up of about 210 dB re 1 µPa, for which the avoidance reaction would be expected to range out to about 3 km. The theodolite tracking technique has proven well suited to quantifying these avoidance reactions at these ranges, and we will do so for the different frequencies at which the whale-finding sonar operates, from 20 – 40 kHz. The mechanics of the basilar membrane in the gray whale cochlea suggests an upper limit of hearing within or below this range (Ketten 2000). By testing whether this avoidance response disappears at higher frequencies, this study may also bracket the upper threshold of hearing in gray whales. If the lowest frequency of the sonar does not elicit the avoidance typical of low frequency sources, we propose to test one or more lower frequency sources to test for the normal avoidance reaction and to test how low a frequency below the sonar operating frequency is required to evoke the response.*

The primary concerns that have been raised in the past decade about the effects of noise on the marine environment have been related to low-frequency (i.e., less than 1 kHz) and mid-frequency (i.e., 1-10 kHz) sound. High frequency sounds (i.e., greater than 10 kHz) with anthropogenic sources in the marine environment include: (1) fish finding sonars, which operate in the 18-200 kHz region (of which there are thousands deployed world-wide and many off the California coast); (2) depth sounding sonars, with operating frequencies often at 12 kHz (most ships transiting California use these sonars); (3) bottom profilers, which range from 400 Hz to 30 kHz; (4) side scan sonars (50-500 Hz); (5) navigation transponders (7-60 kHz); and (6) various military search and surveillance (2-57 kHz) and mine avoidance (25-500 kHz) sonars. (To date, the Coastal Commission has not attempted to regulate these high frequency sonars, which are fairly commonly used in coastal waters and whose sounds attenuate rapidly in the marine environment.)

Attachments: (1) Dr. Tyack Proposal; (2) NMFS Permit and Conditions; (3) NMFS Federal Register Notice